DETERMINING CUSTOM CALIBRATION FACTORS FOR PHOTOMETERS

APPLICATION NOTE ITI-099

Laser photometers use conventional light-scattering technology to closely estimate aerosol mass concentrations. This technique is well suited for real-time assessments to specific size fraction aerosols. Active sampling photometers typically use an impactor or cyclone to aerodynamically cut an aerosol size fraction from the air stream. Typical fractional cuts include respirable, thoracic, inhalable, PM_{10}, $PM_{2.5}$ and $PM_{1.0}$. Photometers typically detect aerosol particle sizes ranging from 0.1 to 10 µm and aerosol mass concentrations from 0.001 to 100 mg/m^3.

Photometers are ***not*** used for compliance monitoring. Photometric monitoring instruments compliment compliance monitoring activities by providing effective, real-time mass measurements. These real-time measurements can be used for workplace baseline screening and trending, exposure assessments, point source locating, evaluating and testing engineering controls, evaluating material handling interactions, and assist in PPE decision making.

Photometers can measure a variety of aerosols including dust, mist, fume, smoke, fog, condensates, combustion aerosols, and others. These instruments respond linearly to mass concentration across their detection range. Photometers are considered precision instruments. The accuracy of the measurement is dependent on the type of calibration aerosol compared to the aerosol being sampled.

Laser photometers are typically factory calibrated to a standard test dust. The respirable fraction of standard ISO 12103, A1 Test Dust (formerly known as Arizona Road Dust), is the most commonly used. A1 Test Dust has a very uniform particle size distribution over the detection range and is representative of a wide variety of ambient aerosols.

When more accurate measurement data is needed, custom calibration factors must be developed for the specific aerosol. A custom calibration factor is a multiplier applied to raw data to more closely represent the desired results. Custom calibration factors are linear and are good only for a specific aerosol and a specific application or work area.

A custom calibration factor can be developed by comparing a statistically valid number of side-by-side gravimetric and photometric samples.

Steps to Develop a Custom Calibration Factor

Equipment needed:

- Factory calibrated photometer
- Personal sampling pump with sampling train and sampling media

1. Select work area where a specific type of aerosol predominates:
   - Different work areas with different processes will need different custom calibration factors
2. Set up photometer and sampling pump in similar manner:
   - Use the same inlet conditioner/cyclone/impactor, etc.
   - Use the same flow rate
   - Zero and calibrate the photometer prior to sampling
   - Calibrate the sample pump prior to sampling
3. Co-locate both samplers side-by-side.
4. Start photometer and sampling pump at same time, for same duration:
   - Data log aerosol measurements with photometer
   - Collect gravimetric sample with sample pump
   - Sample time does not need to be full shift like compliance monitoring
5. Sample a statistically valid number of samples:
   - Review gravimetric data as it becomes available
   - Conduct more sampling if considerable data variability is found
6. Compare photometric and gravimetric data:
   - Calculate averages for each
7. Calculate new custom calibration factor using the formula below:

   CCF = Custom Calibration Factor
   Reference Concentration = Gravimetric Concentration
   Data Log Concentration = Photometric Concentration
   ECF = Existing Calibration Factor

$$CCF = \frac{\text{Reference Concentration}}{\text{Data Log Concentration}} \times ECF$$

8. Enter new Custom Calibration Factor into the photometer.
9. Repeat the sampling process using new CCF in photometer.
10. Compare gravimetric and CCF photometric sample data:
    - Results should be closer, “more accurate,” using the CCF
11. Determine second Custom Calibration Factor from new data using formula above.
12. Enter second Custom Calibration Factor into the photometer:
    - Photometer results should now be more accurate

Using this procedure, custom calibration factors can be developed for different workplace aerosols. Now the photometer can be used for daily real-time exposure assessment. Remember, this does not take the place of compliance air monitoring. There are no agency-established guidelines or accuracy requirements for real-time aerosol monitoring. However, using gravimetric sampling data as a base line, a photometer programmed with a custom calibration factor can be used to quickly identify potential workplace exposures in real time.

UNDERSTANDING, ACCELERATED

TSI Incorporated – Visit our website **www.tsi.com** for more information.

USA	**Tel:** +1 800 874 2811	**India**	**Tel:** +91 80 67877200
UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8251 6588
France	**Tel:** +33 4 91 11 87 64	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

kenelec scientific measuring up

Distributed by:
Kenelec Scientific Pty Ltd
1300 73 22 33
sales@kenelec.com.au
www.kenelec.com.au

ITI-099 Rev. B (9/26/2012) Printed in U.S.A.